

The President then asked Professor Laurie Lawrence to deliver the lecture for the evening on :-

## **"Metamorphic Minerals"**

The term metamorphism is derived from the Greek and refers to a change of form. This may relate to a change in the shape of the rock itself or equally to the reconstituted minerals that go to form the rock. The process of metamorphism has provided a whole range of names of rocks such as hornfels which connotes extreme toughness, often with a horn-like lustre and usually involves an increase in the specific gravity reflecting the pressure of formation. Other names of metamorphic rocks are schists characterised by flaky minerals such as mica, and rocks such as gneisses, slates, marbles etc.

In an earlier lecture in his series Professor Lawrence referred to the elements making up the earth's crust, Oxygen, silicon, aluminium, iron, calcium, sodium, potassium, magnesium and titanium, - just nine comprising 99.25% of the crust to a depth of 30 km. For example just two minerals such as augite which is  $(Ca,Na)(Mg,Fe,Al,Ti)(Si, Al_2)O_6$  and orthoclase which is  $KAlSi_3O_8$ , contain all the major elements that make up the earth's crust.

It follows that when these primary rocks weather into sedimentary sands, gravels, muds and clays and these sediments are altered by metamorphism, there will not be a change in the total elemental composition of the material, there are no compositional surprises. Metamorphism is in response to changes in temperature and pressure brought about by two types of geological processes. Contact or thermal metamorphism occurs when heated magma is forced through sedimentary layers and the rocks are heated to 500-600 deg C and subjected to great compressive and vapour pressure. Pressure or regional metamorphism may occur over a much wider area where change is brought about due to large sections of crust being forced against one another causing rocks to be heated to similar temperatures as when in contact with magma but due to the immense pressures.

The changes caused in sedimentary rocks by metamorphism include sandstones being converted into quartzites, shales into cordierite hornfels, and limestones into marbles and calc-silicate hornfels such as grossularite, diopside, calcite and wollastonite. By means of slides the speaker pointed out features of the metamorphosed land topography in the Bathurst area and particularly referred to the Wallang area where an abnormal or metastable assemblage of limestones and quartzites is found due to the incomplete conversion of the calcium and silicate components into wollastonite which would have needed higher temperatures and a longer time period.

A number of other high temperature minerals characteristic of metamorphic rocks were described, specimens of some of these being displayed to the Meeting. Mullite, aluminium silicate,  $Al_6Si_2O_{13}$  is one of the highest temperature minerals known. It was named after the island of Mull off Scotland where deposits were found. The garnet group of minerals are found in metamorphic rocks and the speaker spent some time describing the different types which are silicates of some of the nine major rock-forming elements and have the general formula  $A_3B_2(SiO_4)_3$ . A are divalent and B trivalent cations generally of calcium, iron, magnesium, aluminium, and manganese. Some garnets also contain chromium, titanium and vanadium.

At the end of his lecture Professor Lawrence was pleased to answer a number of questions.